17 th INTERNATIONAL BIOLOGY OLYMPIAD
9-16 JULY 2006
Río Cuarto – República Argentina

PRACTICAL TEST

1

Plant Anatomy, Systematics and Physiology
植物解剖、分類及生理

Student code: 學生代碼	

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General remarks about the practical tests

DEAR PRATICIPANS 參賽者

The practical test are organized in four different laboratories. 實作在 4 間不同實驗室進行

Nº 1- Plant Anatomy, Systematics and Physiology 植物解剖學，分類學和生理學

Nº 2- Animal Anatomy, Systematics and Ecology 動物解剖學，生態學和分類學

Nº 3- Biocheminstry 生物化學

Nº 4- Microbiology 微生物學

- You have **1 hour** in laboratories Nº 1 and Nº 2. 實驗 1 及 2 為 1 個小時
- You have **1 hour 30 minutes** in laboratories Nº 3 and Nº 4. 實驗 3 及 4 為 1.5 個小時
- You can score maximum **40 points** in each laboratory, which means a total of **160 points** for the practical test. 每個實驗你最多可得 40 分，實作試驗共 160 分

Good luck !!!!!!!

Practical test Nº 1: Plant Anatomy, Systematics and Physiology

In this laboratory task you will have to work on the morphological, taxonomic and physiological aspects of higher plants in an integrated way.
在這項實作，你必須綜合高等植物之形態學，分類和生理等方面的操作結果。

Aims

目標

A) To identify and compare vegetative organs.

鑑定並比較各營養器官

B) To identify different taxa.

鑑定不同分類群

C) To relate leaf anatomy to photosynthetic pathways.

將葉片解剖構造應用到光合作用過程的路徑

Materials: 材料

- 5 samples (labeled 1-5). 5 項材料(編號 1-5)
- 5 slides. 5 片載玻片
- 5 coverslides. 5 片蓋玻片
- 1 razor blade. 1 支刀片
- 1 felt-tip marker for glass. 標示玻璃用的筆
- 1 tweezers. 1 支鑷子
- 2 histological needles. 2 支解剖針
- 1 dropper with distilled water and glycerin. 1 個滴瓶(內含水及甘油)
- 1 Petri dish with Safranin solution (it stains lignin). 1 個培養皿(含染木質素的染料)
- 1 Petri dish with distilled water. 1 個培養皿(含蒸餾水)
- 1 microscope. 1 台顯微鏡
- Figure 2: microphotographs with details of leaf sectors. 圖 2 為葉片細微構造圖(另附)

Procedure 操作過程

- Cut cross sections of sample 1. 操作材料 1 的橫切
- Place the sections into the Safranin solution. 把切片放入染木質素的 Safranin 染料中
- Transfer the sections to the Petri dish with distilled water to remove the excess of stain. 把切片放入含蒸餾水之培養皿中，除去過多的染料。
- Place the sections on a slide with water and glycerin and cover with a coverslide. 把切片放在載玻片上，滴一滴水和甘油溶液，並蓋上蓋玻片。

Repeat the procedure to obtain histological slides of the remaining samples.
重複以上操作過程，完成其他的材料切片製作。

Observe the obtained histological slides with the microscope. Remember to start observing with the lowest magnification power and then, end up with the 40x objective lens.
以顯微鏡觀察你製作的組織切片。 記得由低倍觀察至 40x 物鏡。

After examining each specimen and your prepared histological slide answer the following questions:
在檢視各材料及你製作的組織切片後，回答以下問題

Q1 : Fill in the organ code number in the appropriate box.
把器官代碼填入適當空格 (7.5 分)

Codes:
代碼

01- stem.莖

02- root.根

03- leaf. 葉

04- rhizome. 根莖

Sample	1	2	3	4	5
Code 代碼					

Q2 : Identify the taxon to which each sample belongs, to write its number in the appropriate box. (5 points)

鑑定出每個材料所屬的分類群，把材料號碼填入適當空格(5 分)

Taxon 分類群	Sample number: 材料號碼
Ginkgophyta 銀杏植物門	
Pinophyta 松柏植物門	
Cycadophyta 蘇鐵植物門	
Magnoliophyta - Magnoliopsida 被子植物門 – 雙子葉植物	
Magnoliophyta-Liliopsida 被子植物門 – 單子葉植物	

Q3 : The endodermis is a layer of cells that performs an important physiological role. Indicate with an "X" the sample/s where this cellular layer is observed. (2 points)
內皮是一層具有重要生理角色的細胞。 在可觀察到此細胞層的材料之空格中標示"X"。(2 分)

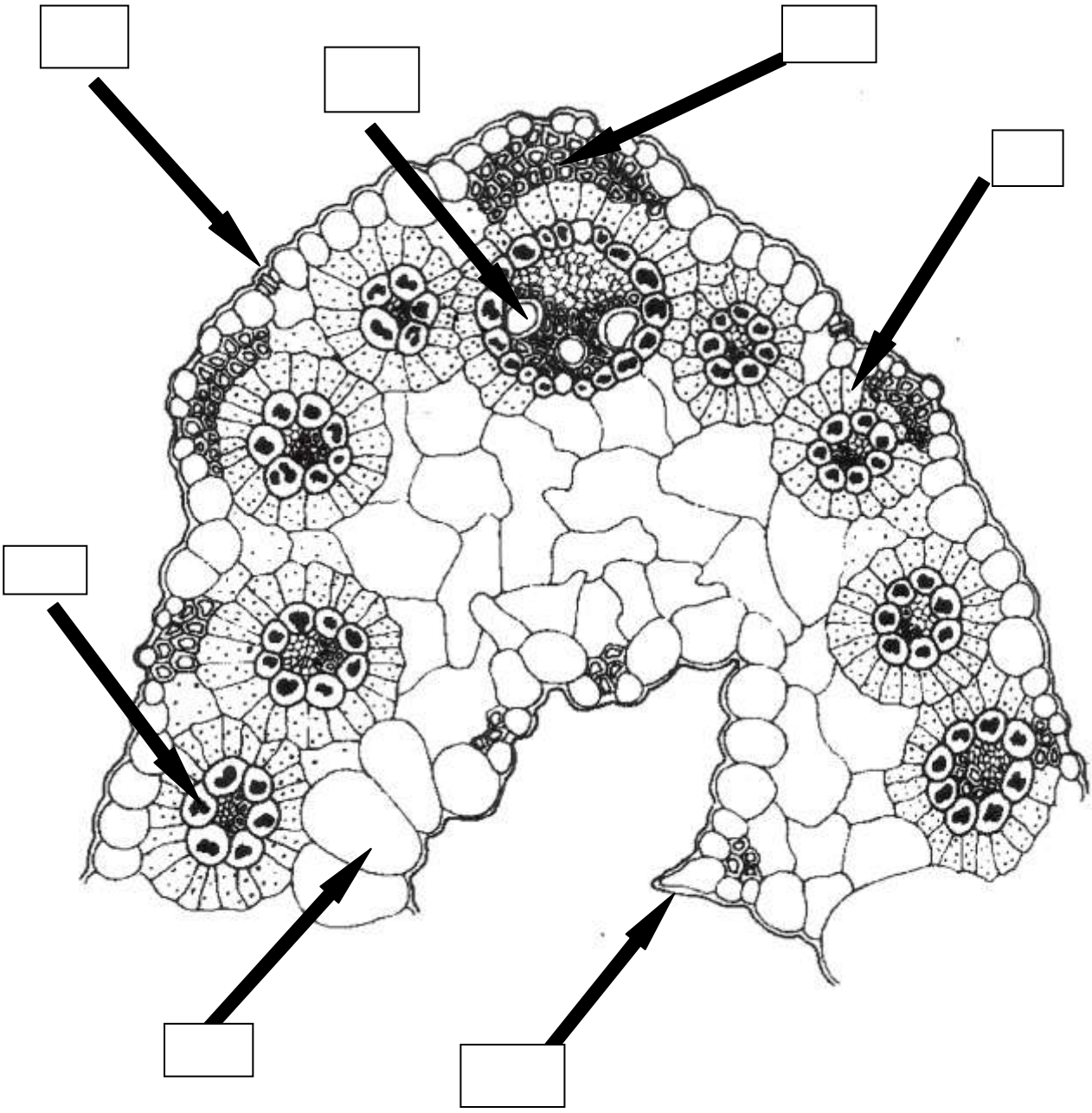
Sample 材料	1	2	3	4	5

Q 4: Plants may differentiate collenchyma and sclerenchyma as supporting tissues. Both tissues show particular cytological characteristics that allow us to identify them. Circle the option that contain/s the sample number/s where collenchymatic tissue is observed. (2.5 points)
植物可分化出厚角組織及厚壁組織，作為支持組織。 兩種組織具特別的細胞特性可供區別。 選出具有厚角組織的材料號碼。(2.5 分)

a) 1, 2, 3.
b) 4, 5.
c) 4.
d) 2.
e) 1, 4.

Q 5: Examine carefully the leaf anatomical structure represented in the **figure Nº 1.** (4 points) 仔細檢查圖 1 之葉片解剖構造，回答以下問題。(4 分)

Figure Nº 1: leaf anatomical structure 圖1-葉片解剖構造



Could this leaf structure correspond to some of the organs previously cut and be part of the same plant? Circle the correct option.

此葉片構造是否能與先前切的一些器官相符，並且是相同的植物的一部分嗎？ 把答案圈選出來。

YES NO

If the answer was affirmative, indicate with an “X” the corresponding sample/s.
如果答案是肯定的，以“X”在對應的材料上作標示。

Sample 材料	1	2	3	4	5

Q 6: Microphotographs with details of leaf sectors are shown **(Figure nº 2)**. Select the codes of those microphotographs corresponding to the sectors pointed out in the leaf diagram represented in **Figure nº 1** . (5.6 points)
顯微照片的詳細葉片構造顯示如圖 2(另附)。 選擇符合部位的顯微照片之代碼，在葉片圖 1 所表示的構造之空格中。(5.6 分)

Q7: Keeping in mind all the anatomical characters observed when completing **figure 1** you could infer that this leaf corresponds to a species that belongs to the Family: (circle the correct answer) (2.4 points)
當填完圖 1 後，根據此解剖的特徵，推斷這片葉符合屬於哪一科？(2.4 分)

a) Liliaceae. 百合科

b) Fagaceae. 殼斗科

c) Brassicaceae. 十字花科

d) Poaceae. 禾本科

e) Araceae. 天南星科

Q8: Leaf anatomy is related to the environment where the plant grows and it indicates its photosynthetic pathway. Keeping this in mind, observe again the leaf structure represented in **figure 1** and select the codes that correspond to this structure. (4

points)

葉解剖構造與植物生長的環境有關，且它表明其光合作用的路徑。 據此，再次觀察圖 1 所示的構造，並且選擇符合此構造的代碼。

01- It follows the Calvin Cycle photosynthetic pathway or C3 pathway.

它進行卡爾文循環光合作用或 C3 路徑。

02- It has a method of fixation of the additional carbon (not alternative) that works separately from the Calvin Cycle.

它可固定額外的碳(不是其它的) ，並與卡爾文循環分開進行。

03- It shows a stratified mesophyll.

它顯示出分層的葉肉組織。

04- It shows a radiated mesophyll. (Kranz)

它顯示出放射狀的葉肉組織(又稱 Kranz 型)。

05- It shows chloroplast dimorphisms. (and/or sizes)

它顯示葉綠體雙型現象(即形態大小差異)。

06- Optimum temperature for photosynthesis is between 15-25º.

光合作用的最適溫度在 15-25 º 之間

07- Optimum temperature for photosynthesis is between 30º-45º.

光合作用的最適溫度在 30- 25 º 之間

08- It shows two well-developed sheaths around the vascular bundles.

它顯示出兩個發育完全之維管束鞘位於維管束周圍。

09- It shows one sheath around the vascular bundles.

它顯示出在維管束周圍的鞘狀構造。

10- It does not show sheaths around the vascular bundles.

它並沒有顯示出在維管束周圍的鞘狀構造。

11- The decarboxylation phase takes place in different structures of the leaf.

去梭基的過程在葉之不同的部分進行。

Answer: .....

Q9: Complete the following comparative table of the three main photosynthetic pathways of carbon assimilation, keeping in mind the codes for each character. (4 points)
完成以下關於碳同化之 3 個光合作用的主要路徑之比較表，應用各種特徵的號碼。 (4 分)

Enzyme responsible for the initial carboxylation: 起始的梭化作用所對應之酵素

01- Ribulose 1,5 - bisphosphate carboxylase-oxygenase (Rubisco). 二磷酸核酮梭化酶

02- Phosphoenolpyruvate carboxylase (PEPase). 磷酸烯醇丙酮酸梭化酶

03- Sucrose-phosphate synthase (SPase). 蔗糖磷酸合成酶

04- RuBP and PEPase.

05- SPase and PEPase.

Leaf anatomy: 葉片解剖

01- stratified. 分層的

02- Kranz structure. (radiated) 放射狀的

03- succulent. 多肉的

The CO_2 fixation time: 碳的固定時間

01- Day. 白天

02- Night. 夜晚

03- Day and night. 晝夜皆有

First stable product of $C0_2$ fixation: 碳固定後的第一個穩定產物

01- Made up of six carbons. 由六碳組成

02- Made up of four carbons. 由四碳組成

03- Made up of three carbons. 由三碳組成

Efficiency in water use: 水的運用效率

01- Medium. 中等

02- High. 高

03- Low. 低

Photosynthetic rate: 光合作用速率

01- Medium. 中等

02- High. 高

03- Low. 低

Character 特性	C3	C4	CAM
Enzyme responsible for the initial carboxylation: 起始的梭化作用所對應之酵素			
Leaf anatomy: 葉片解剖			
The CO_2 fixation time: 碳的固定時間			
First stable product of CO_2 fixation: 碳固定後的第一個穩定產物			
Efficiency in water use: 水的運用效率			
Photosynthetic rate: 光合作用速率			

Q10: If a plant is placed into a closed chamber and exposed to the light, it is observed that the CO_2 concentration in the air inside the chamber decreases for a while due to photosynthesis. The decrease is gradual but it never reaches the zero value. A balance is reached between the CO_2 captured by photosynthesis and the one released by respiration and photorespiration. This balance is known as CO_2 compensatory point.

如果將一棵植物置於一個密閉空間，並且給予照光，觀察空氣中 CO_2 濃度由於光合作用而下降一會兒。 此降低是逐漸的，但是它從未達到零值。被光合作用捕獲以及因為呼吸和光呼吸所釋放的 CO_2 之間達到平衡。 這平衡被稱為 CO_2 補償點。

In the following graph the effect of the atmospheric concentration of CO_2 on the photosynthesis rate in plants C3 and C4 is observed. The arrows indicate the compensatory points of each plant.

在下圖裡，觀察 C3 和 C4 植物之大氣中的 CO_2 濃度對光合作用速率的影響。 箭頭表示每棵植物的補償點。

Indicate the curve that corresponds to each plant by writing C3 or C4 in the right box. (3 points)

透過在曲線上方的空格中適當填寫 C3 或 C4 ，來表示符合每棵植物的曲線。

Reference:

↑: **compensatory points of each plant**
箭頭表示各植物的補償點